



The Flemish Human biomonitoring program the causal chain : from exposure to effects

Wij doen mee aan de meetcampagne van het Steunpunt Milieu en Gezondheid.

Jij ook?



www.milieu-en-gezondheid.be

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G. Schoeters VITO Belgium



Flanders 'fields'



	Flanders	EU
Inhabitants/km ² ('98)	446	116
private cars/km ² ('00)	205	52
km motorways/100 km ² ('99)	472	108





policy links

(B.S. 03-02-2004) Preventiedecreet Art 51 § 1

– The Flemish government:

1. Can set up a network for surveillance of exposure (measured in humans) and/or effects of exposure to physical and chemical factors in the population, with the intention to take measures to protect public health.

2. Takes at least measures for the development and execution of a program for biomonitoring.

3. Can - in execution of &1 - set up a fund (...). For this purpose a mandatory financial contribution can be imposed on industries or citizens that are responsible for the presence of physical or chemical factors harmful to health.



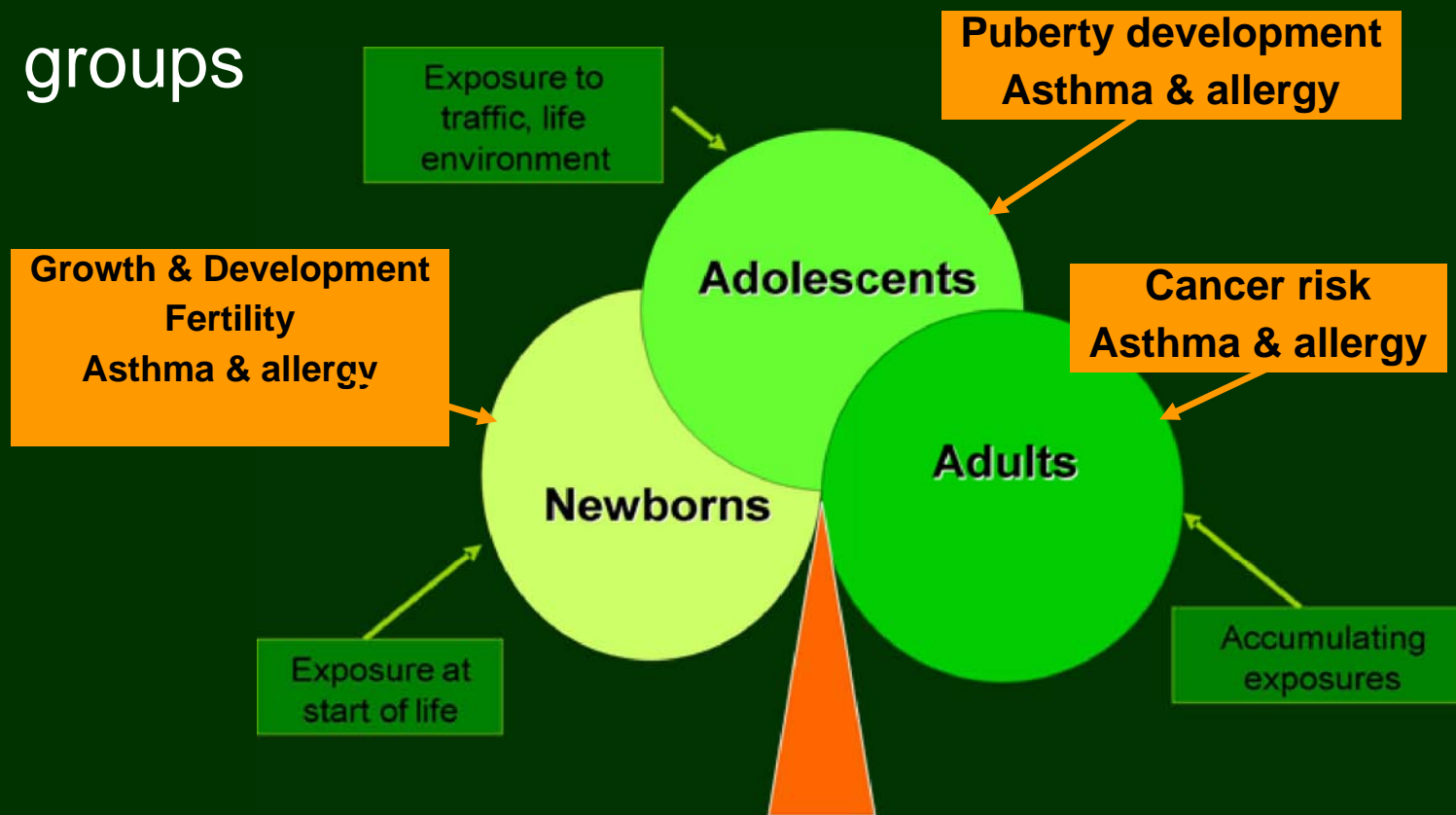
Goals

- **Develop a surveillance program for environmental health → policy support**
 - Identify “base line values” or “reference values” for environmental pollutants in the Flemish population
 - Has the area of residence an impact on the internal pollutant levels and potential biological effects?
 - Can we find a relation between exposure and early effect at the current exposure levels?



Selection of population

- Flemish biomonitoring campaign
 - 2002-2006
 - 3 age groups





Recruitment



- **1200 Newborns and mothers**
 - Period: Sept. 2002 – Dec. 2003
 - Cord blood – questionnaires
 - Medical files of maternity



- **1600 Adolescents (14-15y)**
 - Period: Oct. 2003 – July 2004
 - Blood – urine – questionnaires
 - Medical files of school doctors

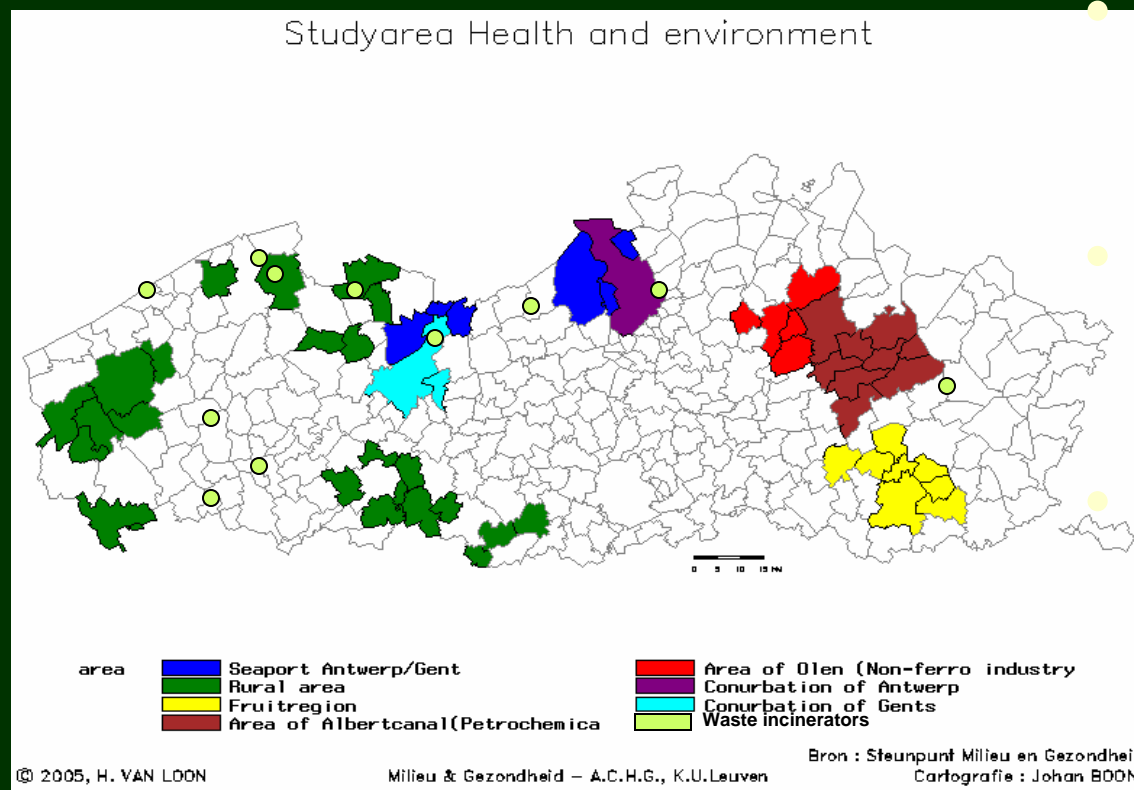


- **1600 Elderly Adults (50-65y)**
 - Period: Sept. 2004 – June 2005
 - Blood – urine – questionnaires



Study areas:

8 study areas in Flanders with typical and different environmental load



Urban regions

- Antwerp
- Ghent

Rural areas

- Rural Flanders
- Fruit orchard region

Industrial areas

- Seaport Antwerp/Ghent
- Non ferro metalurgic
- Petrochemical
- Waste incinerator regions

Representing 20% of the Flanders region



Study areas

➤ **8 study areas** in Flanders with typical and different environmental load:

1. Conurbation of Antwerp

2. Conurbation of Gent

3. Seaport of Antwerp and Gent

4. Rural area

IRCEL environmental monitoring network

population density $< 250 \text{ persons/km}^2$, $< 5\%$ industry, no motorways, no data in emission register

1. Fruit Region

2. Incinerators

3. Olen (Non Ferro)

4. Albertcanal (Petrochemica)

apple+fruit: $> 10 \text{ ha/km}^2$

SS with smoke emission $> 1.20 \text{ mg / m}^3$

SS with lead emission $> 0.9 \text{ ng / m}^3$ ($> \text{Olen}$)

SS with emission of a fictive pollutants $>$
Eindhout



Characteristics of population

	Newborns & mothers	Adolescents	Elderly
Age (years) – range	18-44	14-15	50-65
Age (years) - mean	29.6	14.9	57.6
% women	100%	47%	51%
% smokers	15%	14%	18%
Mean BMI (kg/m ²)	23.3	20.5	26.9
Higher education	22%	49%	32%
Use of local food	42%	51%	49%



Biomarkers of exposure



Biomarkers of exposure

Persistent chlorinated compounds (serum)

Dioxin-like compounds (pg Calux TEQ/g fat)

newborn

adults

Marker PCBs 138.153 & 180 (ng/g fat)

newborn

adolesc.

adults

p,p'-DDE (ng/g fat)

newborn

adolesc.

adults

Hexachlorobenzene (ng/g fat)

newborn

adolesc.

adults

Heavy metals (blood & urine)

Blood lead ($\mu\text{g/L}$)

newborn

adolesc.

adults

Blood cadmium ($\mu\text{g/L}$)

newborn

adolesc.

adults

Urinary cadmium ($\mu\text{g/g creatinine}$)

adults

Metabolites of PAH and benzene (urine)

1-hydroxy-pyrene (ng/g creatinine)

adolesc.

adults

t,t'-muconic acid ($\mu\text{g/g creatinine}$)

adolesc.

Adults



Comparison with health based action limits

adolescents

elderly

Blood lead > 100 $\mu\text{g/L}$

0.2%

1.6%

Blood cadmium > 5 $\mu\text{g/L}$

0%

n=1

Urinary cadmium > 2 $\mu\text{g/g crt}$

-

2.3%

Urinary 1-OH-pyrene > 2 $\mu\text{g/g crt}$

0.2%

1.1%

Urinary t,t'-MA > 0.5 $\mu\text{g/g crt}$

3.5%

4.7%



Exposure: conclusions

- Area of residence is a determinant of exposure
- No alarming trends were detected
- People living in rural areas have high exposure to persistent chlorinated compounds
- Cadmium is problematic in some regions
- Although DDT is forbidden, metabolites are still detected in the human body in considerable amounts
- Factors such as age, gender, smoking and nutritional intake are important determinants of exposure



Biomarkers of effect

Asthma and allergy
Endocrine effect markers
Genotoxic effect markers



Biomarkers of effect

- Extra monitoring instrument:
 - Large number of pollutants in the environment
 - Limited possibility for analysis: technically and financially
 - Pollutants with the same mechanism of action in the body



Biomarkers of effect

- Early markers for important health problems

- Asthma and allergy

mothers	adolesc.	adults
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- Endocrine effect

- Hormone disruption: TSH, sex hormones,

- Diabetes

newborn	adolesc.	adults
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- Puberty

	adolesc.	
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- Fertility, time to pregnancy

mothers		
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- Miscarriages

mothers		adults
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- Genotoxic effect

- Tumor markers (CEA, P53, PSA for men)

		adults
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- DNA damage (Komet assay, micronucleustest, 8OHdeoxyguanosine)

	adolesc.	adults
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Asthma & allergy – reference means

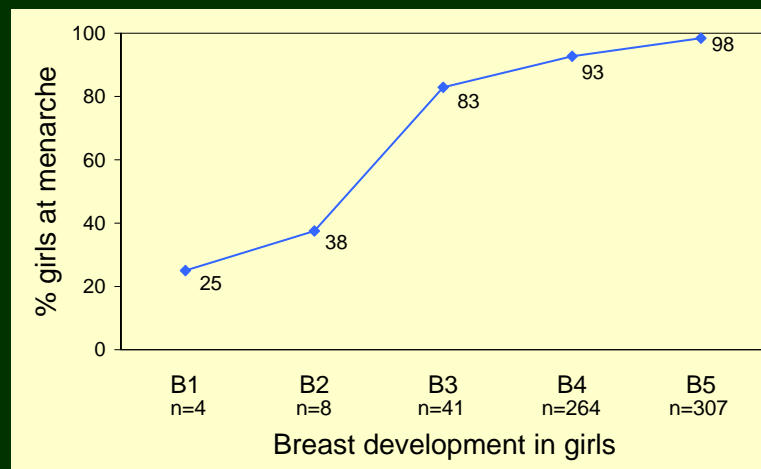
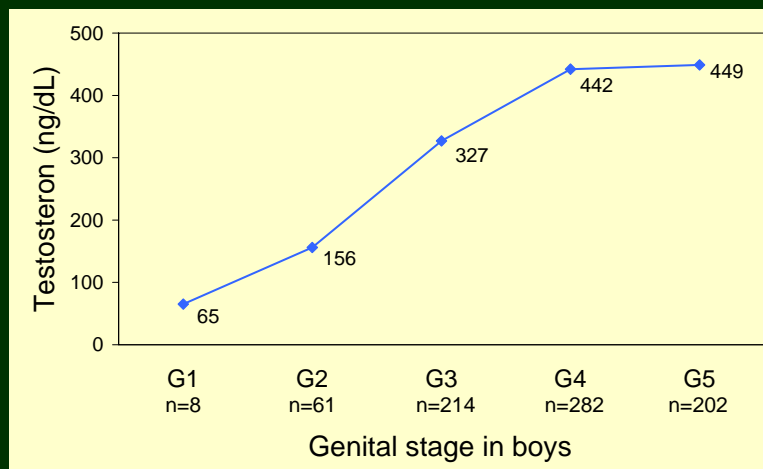
	adolesc.	mothers of newborns	adults
	14-15 y.	18-44 y.	50-65 y.
Asthma - doctor	8.8%	4.3%	5.5%
Asthma - ever	25.3%	16.2%	15.3%
Hay fever - doctor	22.8%	34.2%	21.4%
Food allergy	25.5%	7.0%	22.7%
Contact allergy	21.5%	11.3%	24.9%
Allergy for animals	10.8%	12.0%	1.1%



Endocrine effects

Adolescents

- **Thyroid hormones** (♀ & ♂) and **sex hormones** (♂)
- **Age at menarche** (♀) and **pubertal stages** of Marshall and Tanner (♀ & ♂)
 - validation against questionnaires and blood hormones





Health effects: conclusions

- Asthma and allergy occur frequently in Flanders; regional differences are present between cities and rural areas
- Some endocrine and genotoxic markers differ between regions, but the clinical relevance is probably low
- Several dose-response relationships were detected:
 - asthma and allergy vs. heavy metals and chlorinated persistent pollutants
 - endocrine effects vs. lead and chlorinated persistent pollutants
 - genotoxic markers vs. heavy metals and PAHs



Follow-up research programs (health effects)

- Neuro-psychological development of children
 - 209 children
 - 42 months
 - 4 areas (Rural, Non ferro, Waste incinerators, Harbours)

Dr. M. Viaene- OPZ Geel

– Asthma and allergy

- 36 months
- 145 children
- 2 areas (Rural, Antwerp city)

Prof K. Desager (UZA) & Dr. V. Nelen (PIH)

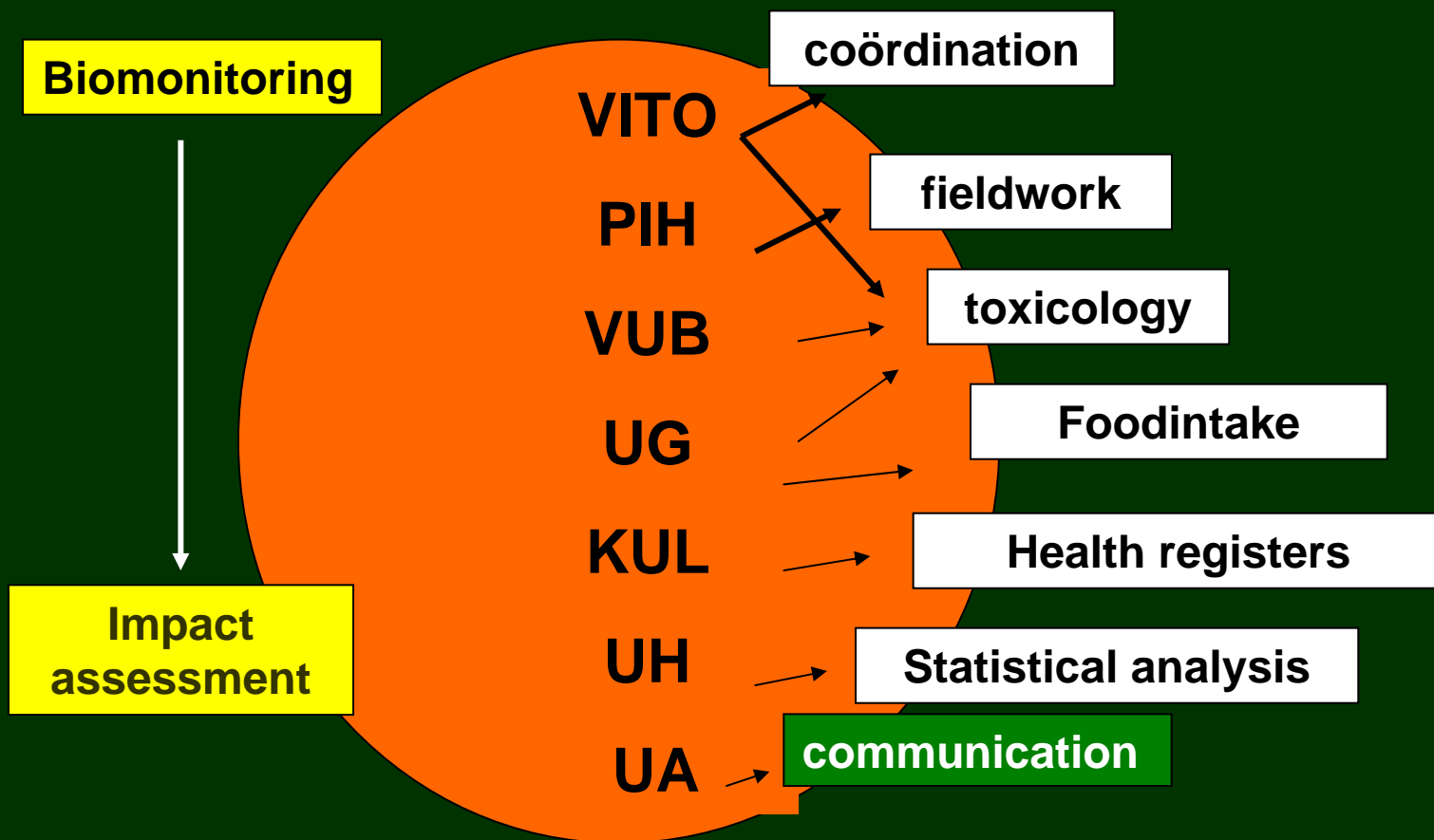


Policy support

- Follow-up programs (Policy support)
 - Multiphase approach
 - Phase 0: Identification of deviating HBM values;
 - Phase 1: Evaluation of the severity of deviations with regard to seriousness and priority;
 - Phase 2: Identification of the cause of the deviation, potential sources
 - Phase 3: Proposal of policy and risk management options



Multidisciplinary team operating via a fieldwork committee





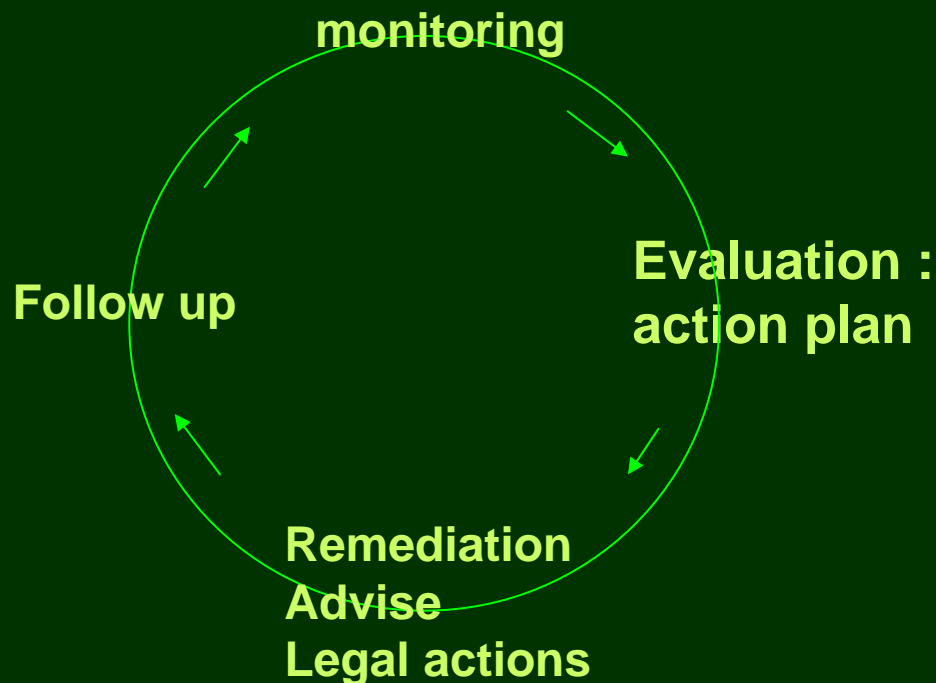
HBM a participatory process based on transparency and openness

- Approval by ethical and privacy commission
- Communication of individual results to the participants
- Communication of collective results to participants, policy makers, local authorities and large public
- Information network including MMKs
- BIOMONITOR newsletters
- Web site <http://www.milieu-en-gezondheid.be>



Health in the centre of environmental policy

Development of an environmental health care system





Scientific partners

Coordination : Prof. G. Schoeters (VITO)

Field work: Dr V. Nelen and E. Van de Mieroop

Statistics : Prof G. Molenberghs and L. Bruckers (UH)

Toxicology : Dr G. Koppen, Dr E. Den Hond, E . Brits (VITO)

Prof . W. Baeyens (VUB), Prof N. Van Larebeke (U Ghent)

Astma and allergy: Prof K. Desager; Dr. V. Nelen

Food : Prof G. De Backer , Prof. Dehenauw, M. Bilau, Prof. J. Willems

Communication: Prof I. Loots; Prof L.Goorden; H. Keune;G. Nulens
(UA)

Registers : Prof. Van Ioon; Dr. G. Van Kersschaver, C. Reynders

Environment and health administration : D. Aerts, L. Casteleyn,
K. Van Campenhout

Health Administration : D. Wildemeersch, H. Chovanova



<http://www.milieu-en-gezondheid.be>

Thanks to

4400 participants

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from CLBs,**

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Vlaanderen, Gent & Stamcellenbank, Hematologie – UZ
Gasthuisberg, Leuven**

**Center for diagnosis of metabolic diseases : Antwerpen,
Gent en Brugge**

Kind en Gezin

Environmental health professionals